EVALUATION OF

THE VILLAGE OF GRAND VALLEY

WATER POLLUTION CONTROL PLANT

Ministry
of the
Environment

Evaluation of
the Village of Grand Valley
Water Pollution Control Plant

By

Ministry of the Environment
West Central Region

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GRAND VALLEY
WATER POLLUTION CONTROL PLANT
EVALUATION REPORT

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1.0 INTRODUCTION

A routine inspection of the Grand Valley Water Pollution Control Plant was conducted on November 3, 1977 in order to evaluate the operation of this facility and update our current files.

1.1 Summary

The Village of Grand Valley is served by a Ministry operated 132,000 gpd Water Pollution Control Plant.

The majority of wastewater generated by the Village is collected by a network of sanitary sewers and flows by gravity to the main pumping station located at the treatment plant site. A small sewage pumping station located on Amaranth Street drains a small portion of the Village. Briefly, treatment consists of grit removal, phosphorus removal, extended aeration by employment of an oxidation ditch, final sedimentation and chlorination of the final effluent.

Based on the existing serviced population, approximately 76 per cent of the plant's available organic and hydraulic capacity should, theoretically, have been utilized during the past year. However, based on current average daily flows and organic loadings, only 42 per cent to 44 per cent of the sewage works design organic and hydraulic capacity are presently being utilized. It is assumed that the absence of a municipal water works and major industrial wastewater contributors may partially be responsible for the lower than anticipated loadings to the Grand Valley Water Pollution Control Plant.

As a result of this situation, a small amount of development in excess of this facility's design population has been approved. It is recognized that a large portion of the outstanding housing commitments will be developed on the basis of communal water supply systems. As the provision of communal water usually

results in an increase per capita sewage flows, no further significant development will be permitted to occur within Grand Valley.

An assessment of the impact of additional housing on the plant's remaining reserve capacity will be undertaken as development comes on line.

Analyses results of influent-effluent samples obtained over the past several years and to date, indicate the overall performance of this facility is excellent.

Current loadings to the receiving stream in terms of oxygen demand exerted by carbonaceous BOD indicate the present loadings are well within the assigned assimilative capacity of the watercourse.

However, in the event of a plant expansion, improved phosphorus removal, if possible, and tertiary treatment should be a consideration to prevent the excessive growth of algae and aquatic plants downstream of Grand Valley and to assist in maintaining the total oxygen demand in this stretch of the river at or below 20 lbs BOD/day.

To this affect, additional treatment efficiencies may have to be built into the plant to further reduce the oxygen demand exerted by nitrogeneous BOD. However, as discussed in the report, NOD removal, in the case of Grand Valley, may only be necessary during the warm months of the year. As warm temperatures and solids retention time play a key role in oxidizing ammonia nitrogen, it may be conceivable to achieve a high degree of nitrification if the extended aeration process is retained in the event of a plant expansion.

1.2 Extended Aeration Activated Sludge Process - General Description

This process is commonly used to treat small wastewater flows from schools, housing developments, trailer parks, institutions and small communities.

The aeration period is 24 hours or greater. Because of low BOD loadings, the extended aeration system operates in the endogenous growth phase.

The extended aeration process can accept periodic shock loadings without becoming upset. Stability of the process results from the large aeration volume and complete mixing of the tank contents. Final settling tanks are conservatively designed using low overflow rates and long detention times. Excess sludge is not generally wasted continuously from an extended aeration system. Instead, the mixed liquor is allowed to increase in suspended solids concentration and a large volume of the aeration tank contents are periodically pumped to disposal.

1.3 General Loading and Operational Parameters for Extended Aeration Activated Sludge Plants Having an Average Design Flow between 0.05 - 0.15 MGD

1.3.1 Treatment Efficiency 85-95% BOD removal

1.3.2 Grit Removal in cu.ft./million gals of sewage
2 - 4

1.3.3 Secondary Treatment: Aeration Period - 20-30 hours
: MLSS Range - 3000 - 6000 mg/l (4500 avg)
: Food to Micro-organism Ratio 0.05 - 0.2
: Loading - 5-15 lbs BOD/1000cu.ft./day

1.3.4 Return Activated Sludge: Return Rate
100% of plant influent
: Total Solids Concentration
8000 to 15,000 mg/l

1.3.5 Waste Activated Sludge: Volume - 1000 gals/million gals of sewage

: Total Solids Concentration 8000 to 15,000 mg/l

1.3.6 Final Sedimentation: Detention Period - 3-3.6 hours

: Surface Settling Rate 300-750 max gallons/sq.ft. tank/day

: Minimum liquid depth - 8 feet

1.4 Existing Facilities

1.4.1 Collector System

A system of sanitary sewers ranging in size from 8 inches to 14 inches in diameter serve the built-up portion of the Village. The majority of wastewater generated by Grand Valley flows by gravity to a pumping station located at the treatment plant site.

A small sewage pumping station located on Amaranth Street drains a small portion of the Village.

1.4.2 Sewage Treatment Plant

Raw sewage entering the pumping station is discharged to the sewage treatment plant via fifty feet of 6 inch diameter forcemain.

Preliminary treatment consists of a coarse bar screen and two grit channels. From here, the wastewater is directed to an oxidation ditch where it undergoes biological treatment. An iron coagulant is added to the aeration section to precipitate the phosphorus in the sewage prior to final settling. Final sedimentation is achieved in a circular settling tank. Wastewater leaving the final clarifiers is directed to a 5-pass chlorine contact chamber. Final effluent leaving the plant is discharged to the Grand River via a gravity outfall.

2.0 RESERVE CAPACITY EVALUATION - HYDRAULIC

2.1 Hydraulic Capacity

The Grand Valley Water Pollution Control Plant is designed to treat an average daily wastewater flow of 132,000 gpd. This flow can be broken down into the following components:

2.1.1	Average Domestic Flow	110,000 gpd
2.1.2	School and Arena	9,000 gpd
2.1.3	Infiltration	13,000 gpd

2.2 Average Daily Flows

The average daily volumes of wastewater treated by the Grand Valley Sewage Treatment Plant during 1974, 1975, 1976 and the first nine months of 1977 are contained in Table 1.

TABLE 1

YEAR	AVERAGE DAILY FLOW (gpd)	DESIGN HYDRAULIC CAPACITY (gpd)	RESERVE HYDRAULIC CAPACITY (gpd)
1974	60,000	132,000	72,000
1975	50,000	132,000	82,000
1976	60,000	132,000	72,000
1977	62,000	132,000	70,000

Based on the data contained in Table 1, it is concluded that the volume of wastewater entering the plant has not significantly changed in the past several years. The average daily flow of wastewater receiving treatment represents approximately 47 per cent of the design hydraulic capacity of the Grand Valley Water Pollution Control Plant.

2.3 Reserve Capacity - Hydraulic

2.3.1 Using Design per Capita Flow and Population Ceiling

The plant is designed to treat 110,000 gpd of wastewater generated by the Village, (School, Arena and Infiltration excluded).

A population ceiling of 1,100 persons was assigned to Grand Valley based on an average daily design per capita wastewater flow of 100 gallons.

The 1976 serviced population within the Village was 902 persons. Subtracting this figure from the design population of 1,100 persons, an additional population of 198 persons could be served by the sewage treatment plant.

A review of our records indicates that a unit equivalent of 158 single family dwellings are currently committed to the sewage treatment plant.

Assuming an occupancy rate of three persons per dwelling, it is estimated that an additional population of 474 persons is committed to the sewage treatment plant.

The aforementioned figure represents a potential overcommitment of 276 persons.

2.3.2 Using Actual per Capita Flow and Hydraulic Reserve Capacity

During 1976, an average daily wastewater flow of 63,158 gallons was generated by a serviced population of 902 persons.

Based on an hydraulic reserve capacity of 68,842 gpd and an average daily per capita flow of 70 gallons, it was estimated that, under ideal conditions, an additional population of 983 persons could be served by the sewage treatment plant.

As indicated in the previous section, a potential commitment of 474 persons exists within the Village.

Subsequently, the estimated reserve capacity for the Grand Valley sewage treatment plant, assuming no significant increase in average daily per capita flows over the next several years, is in the order of 509 persons.

2.3.3 Discussion of Reserve Capacity Evaluations

It would appear, on one hand, that assigning a population ceiling of 1,100 persons to the Grand Valley sewage treatment plant based on a design average daily per capita flow of 100 gallons may be too stringent in view of an actual average wastewater flow of 70 gallons per capita per day.

On the other hand, evaluating the plant's reserve capacity on the basis of 70 gallons per capita per day was considered too lenient in view of the following.

The majority of new housing coming on line will be developed on the basis of communal water supply systems. As a result, the projected average daily per capita wastewater flows should increase based on the availability of a plentiful supply of potable water and subsequent increase in consumer consumption.

This being the case, it was decided that an average daily per capita wastewater flow of 85 gallons would be more representative of future flows within Grand Valley and also add a built-in factor of safety to our reserve capacity evaluation.

The per capita flow figure of 85 gallons was arrived at by splitting the difference between the design flow of 100 gpcd and current flow of 70 gpcd.

Based on the results of our revised reserve capacity evaluation, an uncommitted reserve capacity of 336 persons is available for additional development within the Village.

3.0 ORGANIC LOADING

3.1 Design Capacity

Based on a design population of 1,190 persons and an average per capita BOD contribution of 0.17 lbs/day, the organic capacity of the Grand Valley STP is estimated to be in the area of 202 lbs BOD/day.

Assuming a design flow of 132,000 gpd, the design BOD concentration of wastewater entering the plant would be approximately 150 mg/1.

3.2 Average Daily Loadings

During 1974, 1975, 1976 and the first nine months of 1977, the following average daily BOD loadings received treatment at the sewage treatment plant.

TABLE 2

YEAR	AVG DAILY FLOW MGD	DESIGN DAILY FLOW MGD	% DESIGN FLOW	AVG DAILY BOD conc RAW mg/1	DESIGN DAILY BOD conc RAW mg/1	% DESIGN CONC	AVG DAILY lbs/BOD	DESIGN DAILY lbs/BOD	% DESIGN LOADING
1974	0.060	0.132	46	113	150	75	68	202	34
1975	0.050	0.132	38	156	150	104	78	202	37
1976	0.060	0.132	46	149	150	99	90	202	45
1977	0.062	0.132	47	168	150	112	104	202	55
AVG	0.058	0.132	44	147	150	98	85	202	42

As shown in Table 2, daily flows over the past several years averaged 58,000 gpd or approximately 44 per cent of design hydraulic capacity of the Grand Valley Water Pollution Control Plant. The average BOD concentration of wastewater entering the plant for the same period was 147 mg/l or 98 per cent of design concentration which is in accord with design expectations and indicates that only limited amounts of extraneous flows are entering the collector system. Combining the flow and BOD concentrations, the BOD loadings treated at the plant averaged 85 lbs per day or about 42 per cent of the design loading.

Based on the results of Table 2, it is generally concluded that loadings to the plant are keeping pace with flows entering the plant.

4.0 PLANT EFFICIENCY - OVERALL PERFORMANCE

4.1 Interpretation of BOD Results - 1976

During 1976, a total of 26 raw sewage samples were submitted to the Ministry of the Environment Laboratories for analyses.

Results of the analyses performed on the samples indicated that the Design BOD Concentration of 150 mg/l was exceeded 58 per cent of the time. The average BOD concentration of wastewater entering the Grand Valley Water Pollution Control Plant was 149 mg/l or approximately 100 per cent of the Design BOD.

Results of the analyses performed on 24 final effluent samples indicated that the Ministry's criterium of 15 mg/l was not exceeded during 1976. The average BOD concentration of treated wastewater leaving the plant was 5 mg/l or 33 per cent of design.

Based on a design BOD concentration of 150 mg/l for raw sewage and an upper limit of 15 mg/l for final effluent, the expected BOD removal should be in the area of 90 per cent.

During 1976, 97 per cent of the BOD was removed from the wastewater by the Grand Valley Sewage Treatment Plant.

4.2 Interpretation of BOD Results - 1977

During the first nine months of 1977, BOD analyses were performed on 20 raw sewage samples.

Analyses results indicated that the Design BOD level of 150 mg/l was exceeded 67 per cent of the time. The average BOD concentration of wastewater entering the plant was 168 mg/l or 112 per cent of Design.

Results of the analyses performed on the 20 final effluent samples indicated that the Ministry criterium of 15 mg/l was not exceeded during the first nine months of 1977. The average BOD concentration of wastewater leaving the plant was 4 mg/l or 27 per cent of Design.

As previously indicated, BOD removal efficiency for this facility should be approximately 90 per cent. During the first nine months of 1977, an average of 98 per cent BOD removal was achieved.

4.3 Interpretation of Suspended Solids Results - 1976

During 1976, a total of 26 raw sewage samples were submitted to the Ministry of the Environment Laboratories for analyses.

Assuming a Design Suspended Solids concentration of 200 mg/l for untreated domestic wastewater, approximately 52 per cent of the samples submitted for analyses exceeded this level. The average suspended solids level of wastewater entering the Grand Valley Water Pollution Control Plant was 212 mg/l or 106 per cent of standard design.

Results of the analysis performed on the 24 final effluent samples indicated that the Ministry's criterium of 15 mg/l was exceeded 21 per cent of the time during 1976.

The average suspended solids concentration of treated wastewater leaving the plant was 9 mg/l or 60 per cent of design.

Based on a design suspended solids level of 200 mg/l for raw sewage and an upper limit of 15 mg/l for final effluent, the expected suspended solids removal should be in the area of 92.5 per cent.

During 1976, an average of 96 per cent of the suspended solids was removed from the wastewater by the Grand Valley Sewage Treatment Plant.

4.4 Interpretation of Suspended Solids Results - 1977

During the first nine months of 1977, Suspended Solids Analyses were performed on 20 raw sewage samples.

Analyses results indicated that the Design suspended solids level of 200 mg/l was exceeded 52 per cent of the time. The average Suspended Solids concentration of wastewater entering the plant was 195 mg/l or 98 per cent of design.

Results of the analyses performed on the 20 final effluent samples indicated that the Ministry's criterium of 15 mg/l was exceeded 14 per cent of the time during the first nine months of 1977. The average suspended solids concentration of treated sewage was less than 9.5 mg/l or 63 per cent of design.

As previously indicated, suspended solids removal efficiency for this facility should be approximately 92.5 per cent. During the first nine months of 1977, an average of 95 per cent removal was achieved.

5.0 PLANT PERFORMANCE - UNIT EVALUATION

5.1 Pumping Station

A custom-built sewage pumping station is located at the treatment plant site. All wastewater flows enter the pumping station and are discharged to the treatment plant via approximately 50 feet of 6 inch diameter forcemain.

The station is equipped with two pumps each having a capacity of 370 gpm at 27'TDH or, if operated in parallel, 650 gpm at 29' TDH.

The pumping station is designed to operate with one pump as lead and the other as standby. In order to increase their respective lifetimes, the pumps are automatically alternated.

A high level switch located in the wet well is utilized to operate both pumps in parallel in case of an emergency.

An overflow to the Grand River is provided in the event of a prolonged power failure.

In summary, the pumping station is capable of handling an hydraulic load of 432,800 gpd or 4 times the plant's design hydraulic capacity with one pump in operation and with two pumps operated in parallel, 936,000 gpd or 7 times the design hydraulic capacity of the sewage treatment facility.

5.2 Grit Removal

Grit removal is affected by two grit channels. Sewage is directed through one tank for a fixed period of time, permitting cleaning and disposal of settled solids accumulated in the adjacent chamber.

For design purposes, grit is defined as fine sand having a settling velocity of 0.074 fps. A channel type grit removal unit is normally designed to provide a controlled horizontal velocity of 1 fps. A velocity greater than 1 fps will cause scouring of the settled grit and impede satisfactory settling of the suspended solids.

Based on the aforementioned design parameters, the length to depth ratio of a channel type grit removal unit should be 13.3:1.

The grit channels located at the Grand Valley S.T.P. are 43 feet in length. As a result, grit could be effectively removed up to a liquid depth of 3.2 feet if the horizontal velocity was limited to a maximum of 1 fps.

The side wall depth of each chamber is two feet and, as such, is well within the maximum depth constraint of 3.2 feet for effective settling.

The overall dimensions of each grit channel are as follows: 43 ft x 2 ft w. x 2 ft swd.

Assuming a: controlled horizontal velocity of 1 fps
: 1.5 ft operating depth (.5 ft freeboard)

Each channel could effectively remove grit from wastewater flows up to 1.6 mgd.

During 1975, a total of 82 cu.ft. of grit was removed from 19.23 million gallons of wastewater, or about 4.3 cu.ft. of grit per million gallons of sewage.

Similarly, during 1976, a total of 30 cu.ft. of grit was removed from 23.05 million gallons of wastewater or about 1.3 cu. ft. of grit per million gallons of sewage.

The amount of grit removed per million gallons/sewage in extended aeration plants designed to treat up to 150,000 gpd is usually in the area of 2 to 4 cu.ft. per million gallons of wastewater.

5.3 Oxidation Ditch

5.3.1 Loadings

The loading to the aeration section of all activated sludge processes is expressed as pounds of BOD applied per day per 1000 cu.ft. of aeration tank volume (lbs BOD/1000 ft^3/day).

Based on a design wastewater flow of 132,000 gpd at an average BOD strength of 150 mg/l, and an available volume of 20,833 cu.ft. within the aeration section, the Grand Valley Water Pollution Control Plant should be capable of effectively stabilizing up to 9.7 lbs BOD/day/1000 cu.ft. of oxidation ditch.

This figure is consistent with the 5 to 15 lbs BOD/1000 cu.ft./day range used in the design of extended aeration activated sludge plants.

The average loadings to the oxidation ditch over the past several years and to date, are contained in Table 3.

TABLE 3

YEAR	BOD INFLUENT (mg/1)	AVG DAILY FLOW (MGD)	lbs BOD DAY	AERATION SECTION VOLUME (1000cu.ft.)	LOADING lbs BOD/DAY Per 1000 cu.ft.	UPPER LIMIT lbs BOD/DAY Per 1000 cu.ft.	% OF DESIGN
1974	113	0.060	68	20.83	3.2	9.7	33
1975	156	0.050	78	20.83	3.7	9.7	38
1976	149	0.060	90	20.83	4.3	9.7	44
1977	168	0.062	104	20.83	5.0	9.7	52
AVG	147	0.058	85		4.05		42

As indicated in Table 3, daily loadings to the aeration section over the past several years averaged 4.05 lbs BOD/1000 cu.ft. of available volume/day or approximately 42 per cent of the design organic capacity of the ditch. These figures indicate that loadings to this section are similar to the overall organic and hydraulic loadings presently entering the Grand Valley Sewage Treatment Plant.

5.3.2 Food to Micro-organism Ratio

The extended aeration activated sludge process is designed to provide micro-organisms with approximately 1/20 to 1/5 of their weight in food per day, i.e., the food to micro-organism ratio should be between 0.05 and 0.2. This ratio is obtained by dividing the total weight of BOD per day in the incoming wastewater (F) by the total weight of volatile suspended solids (M) in the aeration section.

Since volatile solids form an almost constant proportion of the aeration suspended solids for a given plant, mixed liquor suspended solids (MLSS) can be used for plant regulation.

Control of this ratio can be accomplished by wasting sludge.

Food to Micro-organisms ratio for the past several years and, to date, are contained in the following table.

Samples obtained from the aeration section are periodically analyzed for volatile suspended solids. Analyses results indicate that approximately 70 per cent of the aeration suspended solids are volatile.

TABLE 4

YEAR	AVG MLSS (mg/1)	PER CENT VOLATILE	AVG MLVSS (mg/1)	F:M RATIO	RECOMMENDED RANGE
1974	-				
1975	4800	70	3360	.014	.05 - 0.2
1976	2600	70	1820	.043	.05 - 0.2
1977	2576	70	1803	.044	.05 - 0.2

As indicated in Table 4, the food to micro-organism ratio is less than what is normally expected.

As the amount of available food cannot be adjusted, a decrease in the micro-organism population is necessary to maintain a satisfactory ratio between incoming food and micro-organisms and can be accomplished by wasting activated sludge.

Over the past several years, the average level of MLSS in the aeration section has been steadily decreased in order to establish a more satisfactory relationship between the incoming food and micro-organism population within the oxidation ditch.

The annual operating summaries for 1975, 1976 and 1977 indicate that activated sludge has been wasted at increasing rates in order to reduce the micro-organism population within the aeration section to an acceptable level:

i.e. 1975 - 489,000 gals activated sludge wasted
1976 - 508,000 gals activated sludge wasted
1977 - 520,000 gals activated sludge wasted

5.3.3 Return Sludge Rate

The extended aeration process is designed to permit the return of activated sludge at 100 per cent of the design hydraulic capacity.

The sludge pump located at the Grand Valley Sewage Works is rated at 92 Igpm at 2 ft TDH and, as such, is capable of returning 132,480 Igpd of activated sludge or 100 per cent of the plant's design hydraulic capacity.

5.4 Final Clarification

Suggested design parameters for final settling tanks following an extended aeration activated sludge process are contained in the following table:

TABLE 5

AVERAGE DESIGN FLOW (mgd)	DETENTION TIME(Hrs)	SURFACE SETTLING RATE (gpd/ft^2)	MINIMUM LIQUID DEPTH
0.05 - 0.15	3-3.6	300-750 max.	8 ft.

The final clarifier utilized in the Grand Valley Water Pollution Control Plant was designed to treat a design average daily flow of 0.132 mgd.

5.4.1 Detention Time

Based on an effective volume of 16,280 Imp. gals, the detention time of the final clarifier at design flow is three hours.

5.4.2 Surface Settling Rate

The clarifier is 18 ft. in diameter and, as such, has a surface area of 254 sq.ft. At design flow, the surface settling rate of this unit is estimated to be 520 gpd/sq.ft.

5.4.3 Side Wall Depth

The side wall depth of the clarifier is 10.25 ft. and, as such, meets the 8 foot minimum depth requirement.

Based on the aforementioned calculations, it would appear that the final clarification tank should be capable of functioning satisfactorily up to a design average daily flow of 132,000 gpd.

5.4.4 Detention Time and Surface Settling Rate at 1977 Average Daily Flow

During the first nine months of that year, approximately 62,000 gpd of wastewater received treatment at the Grand Valley S.T.P.

At this flow, the average detention period and surface settling rate of the final clarifier were 6.3 hours and 244 gpd/sq.ft. respectively.

5.4.5 Treatment Efficiency

The main purpose of final clarification is to separate the suspended microbial floc from its liquid medium by sedimentation. If separation is satisfactory, a health activated sludge is accumulated on the bottom of the clarifier and, as required, returned to the aeration section to maintain a satisfactory balance between incoming food and micro-organisms or periodically wasted to a holding tank.

Good settling mainly depends on:

5.4.5.1 Aeration tank MLSS with good settling characteristics.

5.4.5.2 Sufficient O_2.

5.4.5.3 Well designed final sedimentation basis.

5.4.5.4 Rapid return.

The effectiveness of a final clarifier can best be expressed in terms of suspended solids removal.

The Ministry of the Environment's objective for the suspended solids concentration in the supernatant leaving the final clarifier is 15 mg/l.

A summary of suspended solids removal within the final clarifier over the past several years and to date is presented in the following table.

TABLE 6

YEAR	(MLSS) INCOMING SUSP SOLIDS (mg/1)	OUTGOING SUSP SOLIDS (mg1/)	PERCENT REMOVAL	PERCENT OF SAMPLES GREATER THAN 15 mg/1
1974	2775	< 17.5	99.4	50
1975	4800	< 23	99.5	43
1976	2600	< 16	99.4	33
1977	2576	< 12	99.5	29

As indicated in Table 6, the incoming MLSS has been maintained in the area of 2700 to 2800 mg/1, resulting in suspended solids removal of approximately 99.5 per cent.

The only exception was the high average MLSS concentration during 1975 which resulted in poorer solids removal. The less than normal treatment efficiency through the clarifier during that year can probably be attributed to poorer activated sludge settling characteristics.

As previously indicated in Section 5.3.3, the average level of MLSS in the aeration section since 1975 has been decreased in order to establish a more satisfactory balance between the incoming food and micro-organism population and, hence, an activated sludge with good settling characteristcs.

The percentage of effluent samples leaving the clarifier that are greater than 15 mg/1 has steadily decreased and is mainly due to the establishment of a good food to micro-organism ratio in the aeration section of the plant.

From a design standpoint, the clarifier has no apparent inherent design problems which would impede satisfactory settling of the MLSS.

5.5 Chlorination

5.5.1 Detention Time

Effluent leaving the final clarifier is directed to a 5-pass chlorine contact chamber. Based on a total volume of 2691 Imperial gallons, this unit provides a detention period of 30 minutes at a design flow of 132,000 Igpd.

During 1976 and the first nine months of 1977, approximately 60,000 gpd and 62,000 gpd of secondary effluent passed through the chlorine contact chamber.

5.5.2 Chlorination

The resultant chlorine contact periods were 65 minutes and 62 minutes respectively. A daily average of 3.15 lbs and 3.07 lbs of liquid sodium hypochlorite were used during 1975 and 1976 to chlorinate the clarifier effluent prior to discharge, resulting in an average daily dosage of 6 mg/l and 5 mg/l respectively.

5.5.3 Bacteriological Examination Results

A summary of bacteriological examination results for 1975 and 1976 and the first nine months of 1977 are presented in the following table.

TABLE 7

YEAR	NO. OF SAMPLES	TOTAL COLIFORM ORGANISMS/MG/L HIGH	LOW	GEOMETRIC MEAN DENSITY
1975	22	171,000	<10	4847
1976	22	1,070,000	10	1459
1977	20	850,000	10	1950

There are no established limits for Total Coliform organisms in the final effluent of a sewage treatment plant. Any increase in the current dosage rate may prove ineffective due to suspended solids in the final effluent interfering with contact between micro-organisms and the chlorine. It is assumed that a further kill would occur in the outfall and receiving stream if a chlorine residual is present after the initial contact period in the chlorine contact chamber.

6.0 ASSIMILATION CAPACITY - TOTAL OXYGEN DEMAND FROM CARBONACEOUS AND NITROGENEOUS BOD

6.1 Existing Limits

Based on the information contained in Table 8, it was recommended that the allowable increase in BOD_5 levels in the receiving stream should be limited to an increase of 1 mg/l above the existing BOD_5 level of 2 mg/l.

At this level, a total oxygen demand of 20 lbs BOD_5/day could be assimilated by the receiving stream prior to residual waste material entering Belwood Lake.

TABLE 8

1)	STREAMFLOW RECORDS (1964-1970)	a) Mean Annual Flow - 297 CFS b) Minimum Day Flow - 3.2 CFS c) Minimum 7-Day Flow - 3.6 CFS
2)	OXYGEN LEVELS	a) Range - 6-10 mg/l (Generally) b) Minimum Flow - 1.8 mg/l (During low flow conditions) c) Expected Low below 6 mg/l during summer and ice covered low flow periods of winter.
3)	GENERAL RIVER QUALITY	a) BOD_5 - 2 mg/l b) Total P - 0.1 mg/l c) Soluble P - 0.01 mg/l d) Free Ammonia - .05 mg/l e) Total Kjeldahl - 1 mg/l f) Nitrate - .7 mg/l

6.2 BOD Loadings

During 1974, 1975, 1976 and the first nine months of 1977, the following average daily BOD_5 loadings were discharged to the receiving stream.

TABLE 9

YEAR	AVG DAILY FLOW(gpd)	BOD CONC OF EFFLUENT (mg1/1)	AVG DAILY lbs BOD_5	LIMIT lbs BOD_5/Day	PER CENT OF LIMIT
1974	60,000	6	3.6	20	18
1975	50,000	6	3.0	20	15
1976	60,000	5	3.0	20	15
1977	62,000	4	2.5	20	12.5

As indicated in Table 9, the average daily BOD loadings were well within the established limit of 20 lbs BOD_5/day Subsequently, the assimilation capacity of the river in terms of BOD should not be a limiting factor with respect to plant expansion.

7.0 PHOSPHORUS LEVELS IN RECEIVING STREAM

The total phosphorus levels in the river downstream of Grand Valley are approaching 0.1 mg/l. As a result, efforts should be made to maintain the concentration of phosphorus below 0.1 mg/l in order to minimize the risk if having excessive growths of algae and rooted aquatic vegetation in the stretches of river downstream of Grand Valley and in Belwood Lake.

7.1 Phosphorus Reduction through Plant

Table 10 contains the average levels of Total Phosphorus in the wastewater entering and effluent leaving the plant during 1974, 1975, 1976 and the first nine months of 1977.

TABLE 10

YEAR	TOTAL PHOSPHORUS mg/l INFLUENT	EFFLUENT	PERCENT REDUCTION
1974	9.3	2.5	73
1975	9.9	3.8	62
1976	8.2	3.5	57
1977	9.9	2.5	75

As indicated in Table 10, fair reduction in the level of Total phosphorus is being achieved.

Over the past year, attempts to reduce the level of Total Phosphorus down to a concentration of 1 mg/l in the final effluent have not been successful. Increasing the amount of chemical coagulant (up to 3 times) and changing the point of application have not significantly lowered the concentration. A review of the effectiveness of phosphorus removal by the addition of chemical coagulants in the extended aeration process indicates removal efficiency is only marginal at best.

8.0 NITRIFICATION - RECEIVING STREAM REQUIREMENTS

Treatment follows a natural sequence of bio-chemical reactions in which nitrogen components are successively oxidized from organic nitrogen, to ammonia nitrogen, to nitrite nitrogen and finally to nitrate nitrogen (most highly oxidized form of nigrogen).

If the Grand Valley Water Pollution Control Plant is to be expanded, complete nitrification may be desirable in order that the Total Oxygen Demand from carbonaceous and nitrogeneous BOD is maintained at or below 20 lbs BOD_5 per day.

A high degree of nitrification can be achieved by utilizing the process of extended aeration.

The existing Grand Valley Sewage Treatment plant utilizes the extended aeration process in the form of an oxidation ditch.

8.1 Nitrification through Plant

A comparison of the relative abundance of organic nitrogen and free ammonia in the raw sewage entering the plant and treated wastewater leaving the plant is contained in the following tables and indicates the majority of unstable nitrogen components in the raw sewage are being successfully oxidized within the aeration section of the plant.

TABLE 11

ORGANIC NITROGEN COMPONENT

YEAR	INFLUENT (mg/l)	EFFLUENT (mg/l)	% OXIDIZED	% REMAINING AS AMMONIA (NITRITE/NITRATE)
1974	-	-	-	-
1975	23	2.2	90.4	9.6
1976	13	1.2	90.8	9.2
*1977	18	.9	95.0	5.0

* January - September inclusive

TABLE 12

AMMONIA COMPONENT

YEAR	AMMONIA NITROGEN INFLUENT (mg/l)	AMMONIA NITROGEN EFFLUENT (mg/l)	% OXIDIZED	% REMAINING AS AMMONIA (NITRITE/NITRATE)
1974	-	-	-	
1975	39	0.6	98.5	2.5
1976	37	2.3	93.8	6.2
*1977	40	4.7	88.3	11.7

TABLE 13

OVERALL PERFORMANCE (TOTAL KJELDAHL NITROGEN)

TOTAL KJELDAHL NITROGEN (ORGANIC NITROGEN & FREE AMMONIA)

YEAR	INFLUENT (mg/l)	EFFLUENT (mg/l)	% OXIDIZED	% REMAINING AS (NITRITE/NITRATE)
1974	62	2.7	95.7	4.3
1975	62	2.8	95.5	4.5
1976	50	3.5	93.0	7.0
*1977	58	5.6	90.3	9.7

* January - September (Incl.)

It has been well established that no treatment plants, including those of the extended aeration type, are capable of achieving complete nitrification year round. However, NOD removal in the case of Grand Valley may only be necessary during the warm months of the year.

As the rate of nitrification increases through a corresponding temperature increase, it may be conceivable to achieve a high degree of nitrification if the extended aeration process is retained in the event of a plant expansion.

9.0 PLANT EXPANSION REQUIREMENTS

9.1 General Requirements

To fall within the guidelines recommended by our Technical Support Section, any future plant expansion should include:

9.1.1 Additional treatment efficiencies built into the plant in order that the total oxygen demand from carbon and nitrogeneous BOD can be maintained at or below 20 lbs BOD/day.

9.1.2 The complete nitrification of all effluent to the nitrate form.

9.1.3 The reduction of phosphorus levels to less than 1 mg/l in the final effluent.

9.2 Terms of Reference for Plant Expansion

In the event of a plant expansion, the following terms of reference were recommended by our Utility Operations Section.

9.2.1 The design capacity of the plant should be doubled (i.e. from 132,000 gpd to 260,000 gpd).

9.2.2 The extended aeration process should be retained to ensure that the release of ammonia is minimized.

9.2.3 The maximum BOD loadings to the receiving stream must not exceed 20 lbs BOD/day.

9.2.4 The provision of tertiary treatment (sand filters with automatic backwash) capable of treating the water pollution control plant effluent at peak flows.

9.2.5 The provision of phosphorus removal facilities.

9.2.6 The provision of standby power to operate the major sewage pumps, the backwash filters and the chlorinator.

9.2.7 Review of the adequacy of the existing collector system.

9.2.8 If warranted, investigate the influence of the existing outfall structure in terms of local flooding and proposed remedial action.

9.2.9 Determine the probable industrial and residential demands on the sewage treatment plant for the next 20 years.

9.2.10 Estimate capital costs of project.

10.0 CONCLUSIONS

10.1 Reserve Capacity (Population Equivalent)

Based on a design population of 1100 persons and existing serviced population of 902 persons, approximately 82 per cent of the design hydraulic and organic capacity of the Grand Valley Sewage Treatment Plant should theoretically have been utilized to treat wastewater flows generated by the Village during the past year.

However, an evaluation of present flows and organic loadings entering the plant revealed that only 42 to 44 per cent of the plant's available hydraulic and organic design capacity is currently being utilized.

The lower than expected average daily flows can partially be attributed to the absence of a municipal water supply system within the Village.

From an organic standpoint, the lower than anticipated loadings to the plant may be the result of no major industrial wastewater contributors within the Village.

As a result of this situation, the Ministry of the Environment has commented favourably towards Ministry of Housing approval of several residential subdivisions which, when eventually developed, will increase the potential serviced population to approximately 1376 persons.

It is recognized that a large portion of the committed housing is to be developed on the basis of communal water supply systems. This being the case, future wastewater flows entering the plant are likely to increase. Therefore, only a limited amount of growth should be permitted to occur within Grand Valley until a more representative evaluation of the plant's reserve capacity can be made. An evaluation of this nature can only be undertaken when the majority of committed housing within the Village has been constructed and fully serviced.

10.2 Plant Performance

10.2.1 Overall

Based on analyses results of samples obtained from wastewater entering and final effluent leaving the plant, the overall performance of this facility was excellent. Average removals of BOD and suspended solids were in the area of 98 per cent and 96 per cent respectively.

10.2.2 Unit Evaluation

Briefly, all components of this system are operating satisfactorily. The MLSS concentration within the oxidation ditch has been slightly reduced over the past two years to ensure a satisfactory balance between incoming food and micro-organisms. Treatment through the aeration section and final sedimentation basin ranges from good to excellent.

10.3 Stream Loadings

Current loadings to the receiving stream in terms of lbs BOD applied/day were in the area of 12 per cent to 15 per cent of the assigned assimilative capacity of 20 lbs BOD/day. As a result, the assimilation capacity of the river in terms confined to oxygen demand exerted by carbonaceous BOD should not be a limiting factor with respect to future plant expansion.

10.4 Phosphorus Removal

The total phosphorus levels in the river downstream of Grand Valley are approaching concentrations considered conducive to the growth of algae and rooted aquatic plants.

Consequently, if possible, provision for improved phosphorus removal should be a consideration in the event of an expansion to the Grand Valley Sewage Treatment Plant.

10.5 Nitrification

In order that the total oxygen demand from both carbonaceous and nitrogeneous BOD can be maintained at or below 20 lbs BOD/day, additional treatment efficiencies may have to be built into the plant, if expansion is to occur. However, as previously discussed, NOD removal in the case of Grand Valley, may only be necessary during the warm months of the year (i.e. low flow periods).

As warm temperatures and solids retention time play a key role in oxidizing ammonia nitrogen, it may be conceivable to achieve a high degree of nitrification if the extended aeration process is retained in the event of a plant expansion.

11.0 RECOMMENDATIONS

11.1 Reserve Capacity

It is recommended that only a limited amount of growth should be permitted within Grand Valley until a more meaningful evaluation of the reserve capacity of the sewage treatment plant can be made. An assessment of this nature can only be undertaken when the majority of committed housing within the Village has been constructed and fully serviced.

11.2 Expansion Requirements

It is recommended that in the event of a plant expansion, provision should be made for the inclusion of tertiary treatment, phosphorus removal and, if necessary, that additional treatment efficiencies be built into the plant to ensure that the release of ammonia is minimized.

A P P E N D I X I

GRAND VALLEY SEWAGE TREATMENT PLANT

SYSTEM DETAILS

1. Provincial Project No. 1-0018-68.

2. Plant Location: West of Emma Street, approximately 625 feet south of William Street.

3. Process - Extended Aeration Activated Sludge.

4. Design Average Daily Flow - Domestic - 110,000 gpd
   - School and Arena - 9,000 gpd
   - Infiltration - 13,000 gpd

5. Design Population - Domestic - 1,100 persons @ 100gpcd
   - School and Arena - 500 persons @ 18 gpcd
   - Infiltration - Not applicable

6. Design BOD Loading - Domestic - 1,100 persons @ 0.17 lbs/capita/day = 187 lbs BOD/day
   - School and Arena Equivalent 90 persons @ 0.17 lbs/capita/day = 15 lbs BOD/day
   - Infiltration - Not applicable

7. Design BOD Conc. - mg/l = $\frac{202 \text{ lbs BOD/day} \times 106}{132{,}000 \text{ gpd} \times 10}$ = 150 mg/l

8. Sewage Pumping Station:
   - Location - at the sewage treatment plant site
   - Type - Custom-built
   - No. of pumps - 2
   - Capacity of each pump - 370 Igpm
   - Capacity operated in parallel - 650 Igpm
   - Automatic alternation with high level switch to operate both pumps in parallel in case of emergency.
   - Extra floor area has been provided in the equipment building for the installation of a standby motor generator set.
   - Overflow to Grand River

9. Forcemain:
   - Diameter - 6 inch
   - Length - 50 feet
   - Velocity @ 370 Igpm - 5.05 fps

10. Grit Channels: Number - 2
: Dimensions - 43 ft x 2 ft w. x 2 ft. swd (each)
: Volume - 1073 Imp. gal (each)
: Detention - 12 minutes
: Bar Screens in Grit chamber

11. Oxidation Ditch: Length - 159 feet
: Design water level - 4.5 feet
: Volume - 130,000 Imp. gal.
: Detention - 24 hours
: Rotor Type - Pumps and Softeners
: Size - 27.5 inch diameter x 10 ft. length
: Motor - 7½ HP @ 1750 rpm
: Oxygen Capacity - 19.8 lbs Oz/hour based on requirement of 2.35 lbs Oz/lb BOD applied

12. Clarifier: Dimensions - 18 ft dia. x 10.25 ft. swd
: Volume - 16,280 Imp. gals.
: Detention - 3 hours
: Surface Settling Rate @ Design - 520 gpd/sq.ft. of tank

13. Return Sludge: Air lift sludge pumps
: Capacity - 92 Igpm or 132,480 Imp.gpd

14. Chlorine Contact Chamber: No. of units - 1 @ 19 ft. x 6 ft. x 5 ft. swd (5-passes)
: Volume - 2800 Imp. gals
: Detention - 30.5 minutes
: Chlorinator Type - Hypochlorinator
: Capacity - 11 US gpd @ 125 p.s.i.

15. Sludge Storage: Number of units - 1
: Dimensions - 12 ft x 8 ft x 9.5 ft swd
: Volume - 5690 Imp. gals

Assuming: 0.20 lbs suspended solids/capita/day @ 1190 persons = 238 lbs susp. solids/day

: 90% removal and 4% solids concentration

Therefore, projected daily production - 238 x 0.9 x 100/4 x 1/10 = 535 gallons

Available Holding Period - $\frac{5690}{535}$ = 11 days

: Supernatant returned to wet well by gravity.

16. Receiving Stream: Grand River
: Assimilation Capacity - Total Oxygen Demand from Carbonaceous and Nitrogeneous BOD's of 20 lbs BOD/day.

A P P E N D I X 11

VILLAGE OF GRAND VALLEY WATER POLLUTION CONTROL PLANT

F L O W D I A G R A M